FINAL

RECOMMENDED REMEDIATION PLAN
AREAS A & B

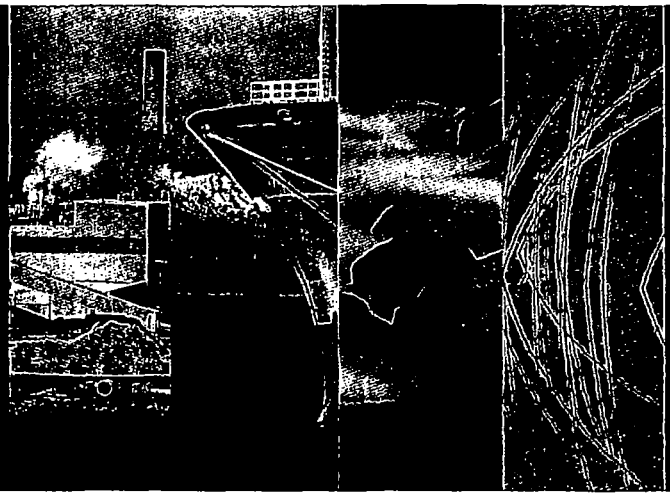
for

Middle Waterway Problem Area

of the

Commencement Bay Nearshore/Tideflats Superfund Site

Tacoma, Washington



prepared for the:

Middle Waterway Action Committee

MIDDLE WATERWAY

Protecting the Environment, Promoting the Economy

November 24, 2000
(Revised April 9, 2001)

ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER ENVIRONMENTAL CORPORATION

FINAL
RECOMMENDED REMEDIATION PLAN
AREAS A AND B
for
MIDDLE WATERWAY PROBLEM AREA
COMMENCEMENT BAY
NEARSHORE/TIDEFLATS SUPERFUND SITE
TACOMA, WASHINGTON

MIDDLE WATERWAY

Protecting the Environment, Promoting the Economy

Prepared for

Middle Waterway Action Committee

Prepared by

Anchor Environmental, L.L.C.
1411 Fourth Avenue, Suite 1210
Seattle, WA 98101

and

Foster Wheeler Environmental Corporation
12100 NE 195th Street, Suite 200
Bothell, WA 98011

November 24, 2000
(Revised April 9, 2001)

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

Anchor	Anchor Environmental, L.L.C.
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
BA	Biological Assessment
CAD	Confined Aquatic Disposal
CBBA	Commencement Bay Biological Assessment
CB/NT	Commencement Bay Nearshore/Tideflats
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of Tacoma
cm	centimeter
COE	United States Army Corps of Engineers
cy	Cubic Yard
DNR	Washington Department of Natural Resources
Ecology	Washington Department of Ecology
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
Foss Maritime	Foss Maritime Company
Foster Wheeler	Foster Wheeler Environmental Corporation
HEA	Habitat Equivalency Analysis
MINI	Marine Industries Northwest, Inc.
MLLW	Mean Lower Low Water
MWBA	Middle Waterway Biological Assessment
MWAC	Middle Waterway Action Committee
NAD 83	North American Datum 1983
Plan	Recommended Remediation Plan, Areas A and B (this document)
Pioneer	Pioneer Industries, Inc.
PRD/RD	Pre-Remedial Design/Remedial Design
PRP	Potentially Responsible Party
ROD	Record of Decision
Simpson	Simpson Tacoma Land Company
SMU	Sediment Management Unit
SOW	Statement of Work
SQO	Sediment Quality Objective

ACRONYMS AND ABBREVIATIONS

SRAL Sediment Remedial Action Levels

1. INTRODUCTION

1.1 BACKGROUND

This Recommended Remediation Plan, Areas A and B (Plan) was prepared as required by Section II.B.1.e and Section II.B.2.h of the Statement of Work (SOW), Appendix I to the Administrative Order on Consent (AOC) (United States Environmental Protection Agency [EPA] Docket No. 10-97-0096/Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA]) for the Pre-Remedial Design and Remedial Design (PRD/RD) Study of the Middle Waterway Problem Area of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site. This Plan is a pre-design document identified in the EPA-approved Revised Final Pre-Remedial Design and Remedial Design Work Plan dated February 23, 1998 (Foster Wheeler Environmental Corporation [in this document known as Foster Wheeler] 1998a). Area C is addressed in the Recommended Remediation Plan, Area C (Anchor Environmental, L.L.C. [Anchor] and Foster Wheeler 2001d).

This Plan is submitted on behalf of the Middle Waterway Action Committee (MWAC), currently consisting of Foss Maritime Company (Foss Maritime), Marine Industries Northwest, Inc. (MINI), and Pioneer Industries, Inc. (Pioneer).

1.2 PURPOSE AND SCOPE OF DOCUMENT

The purpose of this Plan is to recommend a remedial option for Areas A and B of the Middle Waterway to EPA for its consideration and approval. This Plan is based on the evaluation and comparative analysis of the options according to the nine CERCLA criteria provided in the Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001b).

The evaluation and selection of potential confined disposal sites have been completed by EPA and described in the final Explanation of Significant Differences (ESD) for the CB/NT Superfund site (EPA 2000b). The ESD identified the disposal sites for dredged problem sediments from the Middle, Thea Foss, Wheeler-Osgood, and Hylebos Waterways. EPA selected Blair Waterway Slip 1, St. Paul Waterway Nearshore Facility, and upland disposal sites to contain problem sediments dredged from these waterways. Combined disposal of sediments from the Middle Waterway with sediments from the Thea Foss and Wheeler-Osgood or Hylebos Waterways is a key objective of the Middle Waterway AOC and continues to be strongly supported by EPA, the resource agencies, and the general public. This report does not provide further evaluation of these disposal sites beyond a demonstration that combined disposal does not pose any significant issues.

1.3 SITE BACKGROUND INFORMATION

1.3.1 Site Description

The Middle Waterway lies between the Thea Foss Waterway to the southwest and the St. Paul Waterway to the northeast (Figure 1). The waterway has been divided into three areas:

- Area A – This area is characterized by water-dependent uses requiring maintenance of navigational depths and remedial options that take into consideration the integrity of existing structures, future development, and priority for water-dependent uses identified in applicable Coastal Zone Management Programs (e.g., City of Tacoma [City] shoreline program). Sediments that require remediation in this area will be addressed primarily through dredging. Foss Maritime leases aquatic lands from the State of Washington adjacent to the former Cooks Marine facility.
- Area B – This area is the central tideflat area and is the transition between Area A and Area C. Beyond the re-engineering of a bank and construction of the St. Paul Waterway Nearshore Facility habitat plan, the sediments in this area do not require remediation. Portions of Area B are part of the Washington Department of Natural Resources (DNR) aquatic reserve and the proposed St. Paul Waterway Nearshore Facility habitat plan.
- Area C – This area is the head of the waterway. This area is the focus of habitat restoration (e.g., Natural Resource Trustees' [Trustees'] Middle Waterway Shore Restoration, Middle Waterway Estuarine Natural Resources Restoration Project, and the DNR aquatic reserve). Due to Sediment Quality Objective (SQO) exceedances in the subsurface sediments, remedial technologies considered for this area must protect existing habitat by taking into account the potential for recontamination of Area A, Area B, and adjacent restoration projects during and avoiding disturbance to after construction.

The Round 1A Data Report (Foster Wheeler and Anchor 1999a), the Round 1B Data Report (Anchor and Foster Wheeler 2000a), and the Data Evaluation Report (Anchor and Foster Wheeler 2001a) present detailed descriptions of the waterway and should be reviewed for a detailed assessment of conditions within the waterway.

In September 1989, EPA issued the Record of Decision (ROD; EPA 1989) for remediation of sediments and source control in the nearshore and tideflat areas of Commencement Bay. The ROD contains several provisions that directly affect the selection and evaluation of remedial options for the Middle Waterway sediments.

For Middle Waterway sediments where chemical concentrations are below SQOs, no remedial action is necessary. Sediments containing chemicals at concentrations above the SQOs, but similar to the sediment remedial action levels (SRALs), presented in the ROD may be appropriate for natural recovery. In this case, natural recovery processes are expected to reduce chemical

concentrations to concentrations at or below the SQOs within the 10-year recovery period allowed in the ROD. The recovery period begins after sediment remedial actions are completed for areas that are not expected to recover naturally. The ROD anticipated that predictions of natural recovery represented by these preliminary SRALs may be modified depending on the results of more in-depth analysis of natural recovery. Section 9 of the Data Evaluation Report (Anchor and Foster Wheeler 2001a) presents a more in-depth evaluation of natural recovery.

Chapter 8 of the ROD analyzed ten alternatives (i.e., technologies) for remediation of sediments. Five of these alternatives, natural recovery and four confinement options, were determined to be potentially suitable for use in Commencement Bay.

The selected remedy, as described in Chapter 10 of the ROD, includes the following key components:

- Site use restrictions
- Source control
- Natural recovery
- Sediment remedial action
- Monitoring

The technologies identified in the ROD for confinement of contaminated sediments are Alternatives 3 through 6, listed below:

- Alternative 3 – In-Place Capping
- Alternative 4 – Removal with Confined Aquatic Disposal (CAD)
- Alternative 5 – Removal with Nearshore Disposal
- Alternative 6 – Removal with Upland Disposal

Natural recovery is not identified as a numbered alternative in the ROD. It is described as an acceptable option if all or part of a problem area is predicted to recover naturally within a 10-year period following control of major sources. Thin-layer capping (enhanced natural recovery), in which a thin layer (5 to 20 centimeters [cm]) of clean sediment is applied so that natural processes of mixing and ecosystem recovery can take place, is also an acceptable option for areas of the waterway that are not expected to recover naturally as identified in the final ESD (EPA 2000b). Therefore, natural recovery and enhanced natural recovery may be considered as a component of other alternatives to address marginally contaminated areas.

Treatment technologies were not considered cost-effective solutions at the time the ROD was issued. To determine whether that conclusion was still valid, EPA Region 10 asked EPA's National Risk Management Research Laboratory to review CB/NT data generated from the Middle, Thea Foss, Wheeler-Osgood, and Hylebos Waterways and to provide Region 10 with an opinion about the viability and cost-effectiveness of currently available treatment technologies. They concluded that while some new technologies are available, most are in the pilot-study phase and are still not cost-effective (Appendix B of the Evaluation of Remedial Options Report [Anchor and Foster Wheeler 2001b]). Treatment technologies still work best on low-volume, high-concentration wastes rather than the large-volume, low-concentration wastes that

characterize Commencement Bay problem sediments. Treatment is therefore not considered for the Middle Waterway.

1.3.2 Section 404(b)(1) Compliance

EPA has prepared a document to record its evaluation and findings regarding remedial actions in the CB/NT Superfund site pursuant to requirements of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. This Section 404 Compliance Evaluation document (EPA 2000a and Appendix E of the Data Evaluation Report) contains a summary of findings, an evaluation of compliance with the Section 404(b)(1) Guidelines [40 CFR 230.12(a)], and an evaluation of compliance with the public interest [33 CFR 320.4(a)]. The remedial actions covered by this document include dredging and capping in the Middle Waterway. For purposes of this document, the term capping includes enhanced natural recovery described in the July 2000 ESD. The Data Evaluation Report (Anchor and Foster Wheeler, 2001b), the Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001b), this Recommended Remediation Plan, Area A and B (Anchor and Foster Wheeler 2001c), and the Recommended Remediation Plan, Area C (Anchor and Foster Wheeler 2001d) provide all information necessary for EPA to amend the interim final 404 Compliance Evaluation document (EPA 2000a), as necessary.

1.3.3 401 Water Quality Certification Compliance

The Data Evaluation Report (Anchor and Foster Wheeler 2001a), the Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001b), this Recommended Remediation Plan, Area A and B, and the Recommended Remediation Plan, Area C (Anchor and Foster Wheeler 2001d), provide all information and surface water quality analyses necessary for EPA to assess the substantive requirements of the 401 Water Quality Certification. As discussed in Section 12 of the Data Evaluation Report (Anchor and Foster Wheeler 2001a), short-term water quality at the point of dredging is predicted to be in compliance with water quality criteria. The information is also available to assess the potential short-term and long-term water quality impacts associated with confined disposal. Once the disposal site for Middle Waterway sediments is identified and preliminary configurations are complete, MWAC will use the Middle Waterway contaminant mobility testing results to assess the potential for water quality impacts associated with the combined disposal site.

1.3.4 Disposal Sites

Since 1996, EPA has held several meetings and discussions with stakeholders of the CB/NT Superfund site, including potentially responsible parties (PRPs), representatives of federal, state, local and tribal governments, environmental groups, and members of the public, in an effort to identify potential disposal sites that meet the criteria set forth in the ROD (EPA 1989). Ten sites were identified during the process, although EPA further narrowed the list to a few candidate sites.

MWAC, in accordance with the AOC and SOW, submitted a Disposal Site and Mitigation Site Inventory to EPA (Foster Wheeler 1998b), which was subsequently approved by EPA in April 1998. Because EPA was in the process of preparing an ESD that would reflect the disposal site forum process and effectively select disposal sites, EPA has not required MWAC to prepare and submit a Ranking of Disposal Site deliverable.

In June 1999, EPA issued a fact sheet presenting its evaluation of disposal sites for the confinement of problem sediments dredged from the waterways of the CB/NT remaining to be remediated. EPA received comments on the fact sheet from various stakeholders.

In November 1999, EPA issued a draft ESD for the CB/NT Superfund site (EPA 1999) that incorporated comments received on the fact sheet. After the public comment period on the draft ESD closed, a group of four Hylebos Waterway PRPs, with EPA's support and participation, a public outreach process was initiated. This public outreach process consisted of a series of three workshop sessions. In response to the workshop's recommendations, EPA agreed to maximize the capacity of Blair Slip 1 and St. Paul Waterway Nearshore Facility disposal sites and allow the Hylebos PRPs to further develop an on-site upland disposal site.

Consequently, the final ESD (EPA 2000b) selects Blair Slip 1 and the St. Paul Waterway Nearshore Facility and disposal at an upland regional landfill as disposal sites to contain contaminated sediments dredged from the Middle Hylebos, and Thea Foss waterways. EPA will also consider an upland on-site fill as an alternative to disposal at an upland regional landfill. Combined disposal of sediments that require removal is a key objective of the Middle Waterway AOC and continues to be strongly supported by EPA, the resource agencies, and the general public. Disposal of sediments from the Middle Waterway and the Thea Foss Waterway in the St. Paul Waterway Nearshore Facility or disposal of sediments from the Middle Waterway and the outer Hylebos Waterway, and the inner Hylebos Waterway in Blair Slip 1 should be a key objective of EPA's efforts.

1.3.5 Habitat Function and Endangered Species Act Compliance

Section 5 of the Data Evaluation Report (Anchor and Foster Wheeler 2001a) describes existing habitat conditions. The Final Middle Waterway Biological Assessment (MWBA; Anchor and Foster Wheeler 2001e) discusses how various remedial alternatives would affect habitat function.

MWAC's recommended remediation alternatives are presented in the Recommended Remediation Plans (Anchor and Foster Wheeler 2001c and 2001d) and construction drawings and specifications will be developed in the design phase. The potential effects of the recommended remediation plans on threatened, endangered, and candidate species are analyzed in the Middle Waterway Biological Assessment (Anchor and Foster Wheeler 2001e). The MWBA is part of the larger Commencement Bay Biological Assessment (CBBA) authored by EPA. The MWBA

assesses gains and losses of habitat function resulting from the recommended remedial alternatives, using the assessment of existing habitat as a basis.

The impacts and benefits discussions in these reports are limited to the remedial actions in the Middle Waterway. Where the remediation plan involves dredging, the impacts and benefits associated with disposal of the dredge material are not discussed in the Middle Waterway deliverables. It is MWAC's expectation that a disposal fee associated with disposal in one of the two in-water sites selected by EPA (EPA 2000b) will address any compensatory mitigation requirements associated with the disposal site.

1.4 ORGANIZATION OF THIS DOCUMENT

The remainder of this Report is organized into the following sections:

- Section 2. Summary of Recommended Remedial Option
- Section 3. Evaluation Summary of Recommended Remedial Option
- Section 4. References

Tables and figures, which are numbered sequentially according to their appearance in the text, are provided at the end of the text.

2. SUMMARY OF RECOMMENDED REMEDIAL OPTION

The AOC requires MWAC to develop comprehensive remedial options for the cleanup of the entire waterway. In the Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001b), a limited number of comprehensive remedial options for the Middle Waterway were developed and screened. Appropriate technologies were selected for each sediment management unit (SMU) (Figure 2) and then bundled to create a number of alternatives for each area of the waterway.

Two alternatives were created for Area A (Alternatives A-1 and A-2), and one alternative for Area B (Alternative B-1). The Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001bAnchor and Foster Wheeler 2001b) combined these three alternatives, together with alternatives for Area C, into the remedial options that are presented in Table 1. The no action alternative was not discussed further as a waterway-wide remedial option, although selected SMUs do not require further action, as summarized on Figure 2. The Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001b) selected Remedial Option 2, with Alternatives A-2 and B-1 as the preferred remedial option for Areas A and B of the waterway. This Plan only addresses Areas A and B. The plan for Area C is presented under separate cover (Recommended Remediation Plan, Area C, Anchor and Foster Wheeler 2001d).

2.1 DESCRIPTION OF ALTERNATIVES

This section describes the preferred alternatives proposed for Areas A and B (Alternatives A-2 and B-1).

2.1.1 Alternative A-2

Alternative A-2 is comprised of the following elements: mechanically dredge problem sediments in SMUs 1 through 4a, 6, 7, 9, 15 through 24, 26 through 28b, 30 through 38, 40 through 42, and 44 through 47, including side slopes that are located in other SMUs; cap or backfill remaining problem sediments in SMUs 3b, 30, 31, and 32; place a thick cap in portions of SMU 45; enhanced natural recovery in SMU 5a; place a thick cap in portions of SMU 45; allow natural recovery in SMUs 4c, 5b, 8, 10, 11, and 25; take no action in SMUs 12 through 14, 25, 39, 43, and 50. SMUs 3a and 4b would be backfilled with clean sand to eliminate any habitat conversions or loss. Dredged sediments would be disposed of in one of the disposal sites identified in EPA's ESD (EPA 2000b).

This option includes the complete removal of problem sediments in the areas identified for dredging except in SMUs 3b, 30, 31, and 32, where approximately two feet of material would be removed from the area under Cook's Marine and around existing marine railway structures and

clean sands would be placed to return these areas to original grade. This eliminates habitat conversion or loss.

Some of the overwater structure at Cook's Marine may be temporarily dismantled or relocated, if needed, to facilitate removal of problem sediments located under the structure. Similarly, portions of the scow shed could be temporarily dismantled, if needed, to facilitate removal of problem sediments. This will be determined during the design phase of the project. However, MWAC reserves the right to restore such structures following completion of the remedial action.

Sediments would likely be dredged using a mechanical clamshell dredge with an 8 cy to 15 cy digging bucket. Sediments would be loaded onto barges, transported to the disposal site, and placed in the disposal facility. The sediments would likely be dredged to given elevations (except SMUs 3b, 30, 31, and 32). The sediments in SMUs 30, 31, and 32 (within the marine railway and the former small boat ramp) would have the top two feet removed, and a 2-foot clean high-organic sand cap placed over any remaining SQO exceedences to isolate these sediments from the environment. A similar action would be performed in SMU 3b. Capping and backfills will restore dredged areas to the current elevations and eliminate habitat conversion or loss. Replacement of the existing fine-grained sediments with sand may shift the composition of the invertebrate population, but the high organic content of the sand would likely facilitate recolonization. The active marine industry and steep, hardened banks in this area limit habitat productivity. At the marine railway, removal of sediments above the SQOs is complicated by the presence of subsurface structures. In this situation, capping will be used to address any sediments that are inaccessible and remain after the removal action. Final dredge elevations for other SMUs, including a 1-foot overdredge allowance, are shown on Figure 3 and on cross sections presented in Figures 4 and 5.

The vertical limit of SQO exceedences was not fully defined during the Round 1A and Round 1B field efforts for three locations (near the shipway [MW113 and MW116], offshore of the wharf [MW137], and at MW105). The preliminary dredge layout extends below the known limit by up to 2 feet. Elevations of known chemical exceedences were calculated. This value was rounded down to the next whole integer of elevation and a 1-foot overdredge was included. For example:

1. The mudline elevation of MW114 is –16.7 feet MLLW.
2. The depth of SQO exceedences is two feet; therefore, the elevation of SQO exceedences is –18.7 feet MLLW.
3. Round down to –19 feet MLLW.
4. Include 1-foot overdredge, so minimum dredge cut in this area is –20 feet MLLW.

MWAC is required to develop an EPA-approved Construction Quality Assurance Plan (CQAP) and an Operation, Maintenance and Monitoring Plan (OMMP). Together, these plans will present post-remediation monitoring, long-term monitoring, and additional response actions to ensure success of the remedies. Consistent with these plans, it is anticipated that post-construction monitoring would be performed to determine whether additional removal is required at locations where the vertical extent of SQO exceedences was not fully determined. In the event that post-construction monitoring indicates that the new surface has SQO exceedences, MWAC may perform additional dredging, place a cap, or pursue natural recovery.

Side slopes within the waterway are generally cut at 3H:1V; however the toe of the slope in SMUs 15a, 15b, 20, and 21 would be cut such that they have a short-term slope of 1.5H:1V. Clean bank protection material will be placed after these cuts are made to provide greater stability to the bank. The areas under the wharf would be removed. Additional lateral support (e.g., sheet pile wall, soldier piles and concrete lagging, or similar supports) will be required along approximately 655 lineal feet of the wharf to prevent the existing bulkhead from failing during excavation of the banks in SMUs 37 and 45. These cuts would be at the existing slope of 2H:1V. The area adjacent to and under the finger pier would be cut at 2H:1V.

SMU 5b is characterized by surface sediment samples that have minor mercury SQO exceedances (maximum of 1.7 times the SQO). Because of these low concentrations, MWAC may propose during the design phase to perform biological testing. If the results of this testing confirm the absence of adverse effects, then no further action would be required in this area. This area is also being evaluated as a potential restoration site to address any future alleged injury claims in the Middle Waterway.

Pending biological testing, MWAC proposes Enhanced Natural Recovery. The thin layer of material placed in SMU 5a would likely be composed of a 4-inch thick layer of sand and a layer of coarse gravel and small cobble (similar to the existing size of material in this SMU), resulting in an approximately 6-inch layer. The appropriate grain size mix will be determined during the design phase. Modeling results clearly demonstrate that a 10-centimeter placement is environmentally protective, even assuming a small amount of the placed material is transported.

SMUs 4c, 5b, 8, 10, 11, and 25 would be allowed to naturally recover. Modeling performed for and reported in the draft Data Evaluation Report (Anchor and Foster Wheeler 2001a) showed that chemical concentrations would be reduced to concentrations below the SQO within 10 years. SMU 4b will receive a 3-foot cap.

2.1.2 Alternative B-1

This alternative includes mechanically dredging problem sediments along the bank in SMU 53 and taking no action in SMU 54. The sediments in SMU 55 are part of the area that will be

addressed by Simpson during the construction of the habitat mitigation required for the St. Paul Waterway Nearshore Facility. If the St. Paul project does not go forward, this SMU would be subdivided into two SMUs with enhanced natural recovery on the northern portion at MW156, MW158, and MW039, and no action taken in the southern portion. The western bank of Area B (SMU 53) will be removed, and new engineered slope protection will be placed to protect the bank from erosion. Removed bank material would be disposed of in one of the disposal sites identified in EPA's ESD (EPA 2000b).

3. EVALUATION SUMMARY OF RECOMMENDED REMEDIAL OPTION

The ROD (EPA 1989) evaluated the selected remedy against the nine CERCLA evaluation criteria as required by CERCLA guidance (EPA 1988). The Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001b) presented a detailed evaluation of the remedial options against those same criteria. This section briefly discusses the nine CERCLA criteria and summarizes the detailed evaluation of the Areas A and B preferred option against these criteria.

These nine criteria are grouped into three classes based on whether they describe a required level of performance (threshold criteria), technical advantages and disadvantages (primary balancing criteria), or review and evaluation by other entities (modifying criteria):

- Threshold Criteria
  - Overall Protection of Human Health and the Environment
  - Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Primary Balancing Criteria
  - Long Term Effectiveness and Permanence
  - Reduction of Toxicity, Mobility, or Volume Through Treatment
  - Short Term Effectiveness
  - Implementability
  - Cost
- Modifying Criteria
  - State and Tribal Acceptance
  - Community Acceptance

These criteria are defined below:

Overall Protection of Human Health and the Environment—Criterion provides a final check to assess whether each alternative provides adequate protection of human health and the environment.

Compliance with ARARs— Criterion is used to determine whether each alternative will meet all of its identified federal and state action-, chemical-, and location-specific ARARs (Appendix A of the Data Evaluation Report [Anchor and Foster Wheeler 2001a] and the Evaluation of Remedial Options Report [Anchor and Foster Wheeler 2001b]).

Long-Term Effectiveness and Permanence— Criterion addresses the results of a remedial action in terms of the risk remaining at the site to human health and the environment after response objectives have been met.

Reduction of Toxicity, Mobility, or Volume Through Treatment— Criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of problem chemicals as their

principal element. The ROD (EPA 1989) states that the reduction of toxicity, mobility, or volume through treatment of contaminants is not applicable to the technologies described for Alternatives A-2 and B-1 in Section 2. The reduction of toxicity, mobility, or volume through treatment is therefore not discussed further in this Plan.

Short-Term Effectiveness— Criterion addresses the effects of the alternative during the construction and implementation phase of the project.

Implementability— Criterion addresses the technical and administrative feasibility of implementing the alternative and the availability of various services and materials required during its implementation.

Cost— Criterion evaluates the cost of constructing, operating, and maintaining an alternative. Cost estimates should be refined to provide a feasibility study-level estimate with an accuracy of +50 percent to –30 percent.

State and Tribal Acceptance— Criterion addresses technical and administrative issues and concerns that the state and tribes may have regarding each of the alternatives.

Community Acceptance— Criterion addresses concerns that the public may have regarding each of the alternatives.

In this section, the alternatives that make up the Recommended Remedial Option (Remedial Option 2; Alternatives A-2 and B-1) are compared to the nine CERCLA criteria.

3.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

3.1.1 Alternative A-2

Alternative A-2 will provide protection of human health and the environment by removing from the site the sediments with chemical concentrations that exceed the SQOs. These sediments will be relocated to one of the disposal sites identified in EPA's ESD (EPA 1999). These disposal facilities will be designed to contain problem sediments from the Middle and either the Thea Foss and Wheeler-Osgood or the Hylebos Waterways, respectively, and will prevent contaminants from migrating from the site. The sediments in SMUs 30, 31, and 32 (within the marine railway and the former small boat ramp) would have the top three feet removed, and a 2-foot clean high-organic sand cap placed over any remaining SQO exceedences to isolate these sediments from the environment. A similar action would be performed in SMU 3b. Capping will restore dredged areas to the current elevations and eliminate habitat conversion or loss. Replacement of the existing fine-grained sediments with sand may shift the composition of the invertebrate population, but the high organic content of the sand would likely facilitate recolonization. The

active marine industry and steep, hardened banks in this area limit habitat productivity. At the marine railway, removal of sediments above the SQOs is complicated by the presence of subsurface structures. In this situation, capping will be used to address any sediments that are inaccessible and remain after the removal action.

Sediments from SMUs 4c, 5b, 8, 10, 11, and 25 are predicted to recover naturally within a 10-year time period as discussed in the Data Evaluation Report (Anchor and Foster Wheeler 2001a). Habitat functions will gradually increase to base levels for high intertidal riprap, low intertidal gravel and mixed fines, shallow subtidal mixed fines, and areas in all of these elevation ranges with over water structure and mixed fine substrate. SMU 4b will receive a 3-foot cap.

Dredging will initially reduce the benthic and epibenthic invertebrate populations, thereby reducing the amount of prey available to fish and birds. Invertebrate populations would be expected to recover to pre-action conditions within 1 year, and continue to increase over the following year. The chemical exceedences have already stressed the food web, and exposing clean substrate in the bio-available zone will allow a healthier invertebrate population to develop. In the long term, the dredging will improve the quality of the available habitat.

Juvenile salmon are expected to use the site as consistently after remedial action as before. The bulk of the dredging occurs in areas deeper than juvenile salmon prefer (deep subtidal, deeper than –10 feet MLLW; SMUs 1, 2, 6, 7, 9, 16, 17,18, 19a, 19b, 22, 23, 24, 26, 27, 28a, 28b, 38, 40, and 41), with much of the rest of the remediation in areas with steep, hardened banks, which do not provide very productive habitat currently (SMUs 3a, 3b, 4a, 29, 30, 31, 32, 37, and 45). SMU 42 is shallow subtidal, SMU 44 is low intertidal, and SMUs 13a, 15b, 21, 46, and 47 are high intertidal. Remedial activity will take place outside the period of time juvenile salmon are in the area, and recovery will be underway by the time juvenile outmigration next occurs. At this time forage fish species, which are expected to move out of the area during active remediation, will have returned to their normal use of Area A. As discussed above, numbers of prey species will be lower in dredged areas for the first year after remediation.

The addition of clean sands and gravels will reduce chemical stress on the aquatic invertebrate population and allow a healthier population to develop. Use of a thin layer of clean material is intended to prevent the smothering of existing benthic and epibenthic organisms and to facilitate their colonization of the new cap material. The biologically active zone is generally regarded to be the top 0 to 10 cm of sediments, so the thinner the cap material, the more quickly bioturbation and recolonization will occur. The existing surface sediments in this area are silty sand, so addition of a high-organic sand with gravel protective layer might shift the composition of the invertebrate population slightly. The high organic content would likely facilitate benthic recolonization.

The addition of coarse gravel and small cobble to stabilize the slope in SMUs 15a, 15b, 20, and 21 will occur below –10 feet MLLW, with no appreciable resulting habitat effects. Similarly, reconfiguration of the slopes along SMUs 37 and 45 will likely reduce the amount of concrete used for bank stability, but because slopes will remain the same, the resulting effect on habitat availability is not notable.

Habitat function is expected to remain the same in SMUs 4c, 12 through 14, 25, 39, 43, and 50 where no action is proposed.

3.1.2 Alternative B-1

This alternative will provide protection to human health and the environment by removing the problem materials and disposing of them in an engineered disposal facility. Sediments would likely be double-handled and loaded into barges for transport to the disposal site. The disposal facilities will be designed to contain combined sediments from the Middle Waterway and either the Thea Foss and Wheeler-Osgood or the Hylebos Waterways. The disposal facilities will prevent the contaminants from migrating from the site. The engineered slope in SMU 53 would be protected with material of an appropriate size to prevent erosion of the bank.

The work to be performed is upland and in the high intertidal habitat zone (+4 to +12 feet MLLW), above the most preferred juvenile salmon habitat zone of –4 to +4 feet MLLW. The slope work begins in the upland, above +12 feet MLLW, and ends at +6 feet MLLW. The project would maintain the slope in the same configuration.

Removal of problem sediments, including debris, will reduce the chemical stress on aquatic organisms, thus resulting in a net benefit to habitat function. Conversion of concrete slabs and asphalt to rip-rap would provide more interstitial spaces. Fish use such spaces for hiding, and in certain cases over-wintering. Sediment accumulation is more likely to occur in the spaces rip-rap provides, facilitating colonization of invertebrates and aquatic vegetation.

3.2 COMPLIANCE WITH ARARS

Both Alternatives A-2 and B-1 comply with the ARARs presented in Appendix A of the Data Evaluation Report (Anchor and Foster Wheeler 2001a) and in the Evaluation of Remedial Options Report (Anchor and Foster Wheeler 2001b). All the information exists for EPA to ensure that all substantive requirements of these regulations will be adhered to.

3.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

3.3.1 Alternative A-2

Alternative A-2 will be effective in the long-term by removing the majority of the SQO exceedances from within Area A and Area B. This will provide a permanent remedy for the existing problem sediments. The problem sediments left in place near the marine railway will be capped with clean sands to isolate them from the environment. These problem sediments can not practically be removed due to the marine railway structure.

The cleanup of sediments in the Middle Waterway will result in eliminating exposure to existing contaminants, and will provide improved intertidal habitat conditions. Short-term impacts include a temporary degradation of water quality that will occur during periods of dredging and capping. Given the present status of the waterway, these short-term impacts are negligible, and shall be minimized through use of best management practices during remediation. The proposed actions would result in a net benefit to habitat.

This alternative will provide long-term effectiveness by reducing the contaminant concentrations within SMUs 5a and 5b to levels below the SQOs through the application of a thin layer of material (enhanced natural recovery) in SMU 5a and natural recovery in SMU 5b. With source control in place, this will provide a permanent remedy for the existing problem sediments. Coupled with the benefits provided by the cleanup, the actions in these SMUs will not significantly alter existing habitat elevations and will result in a net benefit to habitat function.

3.3.2 Alternative B-1

Alternative B-1 will provide long-term effectiveness by removing bank materials with chemical concentrations greater than the SQOs from within SMU 53. With source control in place, this will provide a permanent remedy for the existing problem sediments. The engineered slope will prevent the bank from eroding into the waterway. Coupled with the benefits provided by the cleanup, the actions in the SMU will not significantly alter existing habitat elevations and will result in a net benefit to habitat function.

3.4 SHORT-TERM EFFECTIVENESS

3.4.1 Alternative A-2

The dredging of problem sediments in the Middle Waterway is expected to take approximately two months. Mechanical dredging of problem sediments could create limited adverse water quality impacts at the dredging site due to resuspension of sediments. If resuspension of problem sediments and turbidity occur at levels of concern, they could be controlled by using clamshell buckets designed specifically to reduce releases of sediments or by using silt or air curtains to

limit the migration of suspended sediments. Operational changes could also be employed to minimize the release of sediments during operations. These could include slower cycle time or not allowing overfilling of the bucket. Water quality would be monitored during dredging operations to ensure water quality standards are met.

There will be minimal risks to the public because sediments will be dredged, placed on barges, hauled to the disposal site, and disposed of. The public will not be within a reasonable distance of these operations. Health and safety monitoring will be initially performed to ensure that workers are protected during operations. Dredging operations would occur during the time when juvenile salmonids are not migrating through the area, eliminating potential impacts to them. Bird use of the area would not be expected to change, given the industrial nature of current activities.

Water quality (turbidity and low dissolved oxygen) is not expected to be an issue when SMUs 5a and 5b are addressed under this alternative, since construction will occur in the dry. Work will occur outside the period juvenile salmonids are in the area.

3.4.2 Alternative B-1

This alternative will present a low risk to the public because no access would be allowed to the areas where the sediments will be excavated (or dredged), transported to the disposal site, and disposed of in the disposal site. Water quality (turbidity and low dissolved oxygen) is not expected to be an issue since construction will occur in the dry. The public will not be within a reasonable distance of these operations. Health and safety monitoring will be initially performed to ensure that workers are protected during operations. Work would be performed outside the period juvenile salmonids migrate through the area.

3.5 IMPLEMENTABILITY

3.5.1 Alternative A-2

Alternative A-2 is readily implementable. Mechanical dredging and the required ancillary equipment are locally available. Local contractors are familiar with the dredging of problem sediments and are experienced at it. The removal of problem sediments from under the wharf and within the scow shed could be performed using floating excavators and/or a smaller (shorter-boomed) dredge. If needed to facilitate removal, the overwater obstructions (decking, stringers, pile caps, and/or the scow shed, could be temporarily dismantled and then restored following completion of the remedial activity. A sheet pile of soldier pile wall would likely be driven within 3 feet (either inshore or offshore) of the existing bulkhead located along the wharf. This may be required, because the bulkhead is exhibiting signs of instability and removing the

sediments in front of it may cause it to completely fail. The slope of the existing bank in front of this bulkhead (2H:1V) will be maintained.

Construction equipment to deliver, place, and spread a thin layer of clean material (dump trucks, loaders, dozers, blowers, etc.) and the required ancillary equipment are locally available. Local contractors are experienced in performing this type of task. The tideflat is very soft and construction equipment will sink into soft intertidal sediments. However, low ground pressure equipment could be utilized. If required, steel plates or similar devices could be used to distribute the weight of the equipment over a larger area. Heavy-duty blowers could be used to apply the thin layer of clean material, which would reduce the amount of tideflat that would be disturbed.

3.5.2 Alternative B-1

This alternative is readily implementable. Terrestrial construction equipment (excavators, loaders, dump trucks, dozers, etc.) and the required ancillary equipment are locally available. Local contractors are familiar with this technology and are experienced at it. Excavated materials could be temporarily stockpiled on site and then loaded onto barges using a clamshell or a conveyor system. Appropriate controls would be implemented to control spillage and prevent any material from entering the water during the rehandling process.

3.6 COST

3.6.1 Alternative A-2

The estimated costs for Alternative A-2 are presented in Table 2.

3.6.2 Alternative B-1

The estimated costs for Alternative B-1 are presented in Table 3.

3.7 STATE AND TRIBAL ACCEPTANCE

This Recommended Remediation Plan addresses the comments compiled by EPA dated October 5, 2000 and February 20, 2001 (Appendix C of the Evaluation of Remedial Options Report [Anchor and Foster Wheeler 2001b). It is expected that state and tribal concerns have been addressed regarding Alternative A-2.

3.8 COMMUNITY ACCEPTANCE

The public comment period for EPA's Middle Waterway ESD will extend over 30 days, during which the public will be asked to provide their evaluation of and comment on EPAs proposed

plan. Any concerns expressed by the community cannot be addressed until after the public comment period.

3.9 RECOMMENDED ALTERNATIVES

The recommended alternatives for Areas A and B are shown in Figure 6.

4. REFERENCES

Anchor and Foster Wheeler. 2000a. Round 1B Data Report. Prepared by Anchor Environmental, Seattle, Washington, and Foster Wheeler Environmental, Bellevue, Washington, for Middle Waterway Action Committee, Tacoma, Washington. June 6, 2000.

Anchor and Foster Wheeler. 2001a. Final Data Evaluation Report. Prepared by Anchor Environmental, Seattle, Washington, and Foster Wheeler Environmental, Bellevue, Washington, for Middle Waterway Action Committee, Tacoma, Washington. November 24, 2000 (Revised April 9, 2001).

Anchor and Foster Wheeler. 2001b. Final Evaluation of Remedial Options Report. Prepared by Anchor Environmental, Seattle, Washington, and Foster Wheeler Environmental, Bellevue, Washington, for Middle Waterway Action Committee, Tacoma, Washington. November 24, 2000 (Revised April 9, 2001).

Anchor and Foster Wheeler. 2001c. Final Recommended Remediation Plan, Areas A and B. Prepared by Anchor Environmental, Seattle, Washington, and Foster Wheeler Environmental, Bellevue, Washington, for Middle Waterway Action Committee, Tacoma, Washington. November 24, 2000 (Revised April 9, 2001).

Anchor and Foster Wheeler. 2001d. Final Recommended Remediation Plan, Area C. Prepared by Anchor Environmental, Seattle, Washington, and Foster Wheeler Environmental, Bellevue, Washington, for Middle Waterway Action Committee, Tacoma, Washington. November 24, 2000 (Revised April 9, 2001).

Anchor and Foster Wheeler. 2001e. Final Biological Assessment. Prepared by Anchor Environmental, Seattle, Washington, and Foster Wheeler Environmental, Bellevue, Washington, for Middle Waterway Action Committee, Tacoma, Washington. November 24, 2000 (Revised April 9, 2001).

Environmental Protection Agency (EPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. EPA/540/G-89/004. Office of Emergency and Remedial Response, Washington D.C.

Environmental Protection Agency (EPA). 1989. Commencement Bay Nearshore/Tideflats Record of Decision. Prepared by EPA, Region 10, Seattle, Washington.

Environmental Protection Agency (EPA). 1999. Draft Explanation of Significant Differences. Commencement Bay Nearshore/Tideflats Superfund Site. Prepared by EPA, Region 10, Seattle, Washington.

EPA (Environmental Protection Agency). 2000a. Interim Final Substantive Compliance with Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. July 31, 2000. Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, WA. Prepared by EPA, Region 10, Seattle, Washington.

EPA (Environmental Protection Agency). 2000b. Final Explanation of Significant Differences. Commencement Bay Nearshore/Tideflats Superfund Site. Prepared by EPA, Region 10, Seattle, Washington.

Foster Wheeler and Anchor. 1999a. Revised Final Round 1A Data Report. Prepared by Foster Wheeler Environmental and Anchor Environmental for Middle Waterway Action Committee. August 23, 1999.

Foster Wheeler. 1998a. Revised Final Pre-Remedial Design and Remedial Design Work Plan. Prepared by Foster Wheeler Environmental Corporation for Middle Waterway Action Committee. February 23, 1998.

Foster Wheeler. 1998b. Disposal Site and Mitigation Site Inventory. Prepared by Foster Wheeler Environmental Corporation for Middle Waterway Action Committee.

National Oceanic and Atmospheric Administration (NOAA). 1996. Habitat Equivalency Analysis: An Overview. Policy and Technical Paper Series, Number 95-1. Damage Assessment and Restoration Program, National Oceanic and Atmospheric Administration, Department of Commerce. June 12, 1996.

Schreffler, D.K. and R.M. Thom. 1993. Restoration of Urban Estuaries: New Approaches for Site Location and Design. Report to Washington Department of Natural Resources, Aquatic Lands Division from Batelle Marine Science Lab, Sequim, Washington.

TABLES

Table 1. Assembly of Alternatives into Remedial Options

Remedial Option	Alternative					
	A-1	A-2	B-1	C-1	C-2	C-3
1	•		•	•		
2		•	•	•		
3	•		•		•	
4		•	•		•	
5	•		•			•
6		•	•			•

Table 2. Cost Estimate for Alternative A-2

Item	Unit	Unit Cost	Alternative A-2 Quantity	Alternative A-2 Extended Costs Upland Disposal	Alternative A-2 Extended Costs Aquatic Disposal
Mobilization/Demobilization	LS	$ 75,000	1	$ 75,000	$ 75,000
Dredge and Transport	CY	$ 9.60	91,500	$ 878,400	$ 878,400
Aquatic Disposal	CY	$ 40	91,500	$ -	$ 3,660,000
Upland Disposal					
Dewater and rehandle	CY	$ 15	91,500	$ 1,372,500	$ -
Transport and Disposal	CY	$ 45	96,075	$ 4,323,375	$ -
Thick Cap (Sand)					
Purchase and Deliver	Ton	$ 7.75	11,300	$ 87,575	$ 87,575
Place	Ton	$ 6.25	11,300	$ 70,625	$ 70,625
Thin Cap (sand)					
Purchase and Deliver	Ton	$ 7.75	350	$ 2,713	$ 2,713
Place	Ton	$ 6.25	350	$ 2,188	$ 2,188
Shore Protection					
Purchase and Deliver	Ton	$ 10.25	14,280	$ 146,370	$ 146,370
Place	Ton	$ 6.25	14,280	$ 89,250	$ 89,250
Structure Demolition	SF	$ 10.00	40,000	$ 400,000	$ 400,000
Structure Rebuild-wooden	SF	$ 50.00	40,000	$ 2,000,000	$ 2,000,000
Sheet Pile	LS	$ 950,000	1	$ 950,000	$ 950,000
Habitat Mitigation	LS	TBD	1	$ -	$ -
Subtotal				$ 10,397,995	$ 8,362,120
Engineering Design	Percent	10%		$ 1,039,800	$ 836,212
Const. Monitoring/Mgmt.	Percent	5%		$ 519,900	$ 418,106
Long Term Monitoring	LS	$ 100,000	1	$ 100,000	$ 100,000
Contingency	Percent	30%		$ 3,119,399	$ 2,508,636
Total				$ 15,177,093	$ 12,225,074

Assumptions: Habitat Mitigation costs to be determined.

Dredged volume based on 81,000 CY based on the depth of maximum SQO exceedence plus one foot of clean sediment and a 10,000 CY overdredge allowance.

Mechanical dredging with a 12 CY digging bucket (production rate of 1,600 CY/Day).

Three 1,500 CY haul barges used.

Two tug boats dedicated to project.

Prices for sand, gravel, and shore protection material from LoneStar Industries

Minimal debris will be encountered.

Thick Cap in SMUs 4b, 30, 31, and 32.

Clean backfill placed in SMUs 3a, 3b, and 4a.

Shore protection at toe of slope in SMUs 15a, 15b, 20, and 21.

Aquatic Disposal is a delivered cost and includes, design construction compensatory mitigation and long-term monitoring.

Dewatering costs based on Port of Seattle East Waterway project

Five percent lime added during dewatering process.

Upland disposal in Subtitle D landfill.

Long-Term monitoring based on $25,000 per event; one event every 2 years; i = 7%; e = 3%

Long-term monitoring does not include monitoring at disposal site.

Long-term monitoring at the disposal facility is included in the aquatic disposal unit cost.

Structure demolition and rebuild costs from Ron McCray, General Construction.

Sheet pile costs based on Sitts & Hill estimate.

This cost estimate is in present day (2000) dollars.

Notes: Aquatic disposal costs are estimated based on preliminary discussions with the Thea Foss PRPs, the Port of Tacoma, and Occidental Chemical Corporation. These costs are subject to revision and are included for cost comparison purposes only.

CY = Cubic Yard

LS = Lump Sum

SF = Square Foot

TBD = To Be Determined

Table 3. Cost Estimate for Alternative B-1

Item	Unit	Unit Cost	Alternative B-1 Quantity	Alternative B-1 Extended Costs Upland Disposal	Alternative B-1 Extended Costs Aquatic Disposal
Mobilization/Demobilization	LS	$ 10,000	0	$ -	$ -
Dredge and Transport	CY	$ 5.03	1,200	$ 6,036	$ 6,036
Rehandling	CY	$ 3.00	1,200	$ 3,600	$ 3,600
Aquatic Disposal	CY	$ 40	1,200	$ -	$ 48,000
Upland Disposal					
Dewater and rehandle	CY	$ 15	1,200	$ 18,000	$ -
Transport and Disposal	CY	$ 45	1,200	$ 54,000	$ -
Shore Protection					$ -
Purchase and Deliver	Ton	$ 13.00	1,680	$ 21,840	$ 21,840
Place	Ton	$ 8.50	1,680	$ 14,280	$ 14,280
Habitat Mitigation	LS	TBD	1	$ -	$ -
Subtotal				$ 117,756	$ 93,756
Engineering Design	Percent	10%		$ 11,776	$ 9,376
Const. Monitoring/Mgmt.	Percent	5%		$ 5,888	$ 4,688
Monitoring	LS	$ 15,000	1	$ 15,000	$ 15,000
Contingency	Percent	30%		$ 35,327	$ 28,127
Total				$ 185,746	$ 150,946

Assumptions: Habitat Mitigation costs to be determined.

Prices for shore protection material from LoneStar Industries.

Mobilization/demobilization included in Alternative A-1 or A-2.

Dredged material will be rehandled on to barges and disposed of in an aquatic site.

Dewatering costs based on Port of Seattle East Waterway project

Aquatic Disposal is a delivered cost and includes, design construction compensatory mitigation and long-term monitoring.

Upland disposal in Subtitle D landfill.

Monitoring based on a one-time monitoring event.

Monitoring does not include long-term monitoring at disposal site.

Long-term monitoring at the disposal facility is included in the aquatic disposal unit cost.

This cost estimate is in present day (2000) dollars.

Notes: Aquatic disposal costs are estimated based on preliminary discussions with the Thea Foss PRPs, the Port of Tacoma, and Occidental Chemical Corporation. These costs are subject to revision and are included for cost comparison purposes only.

CY = Cubic Yard

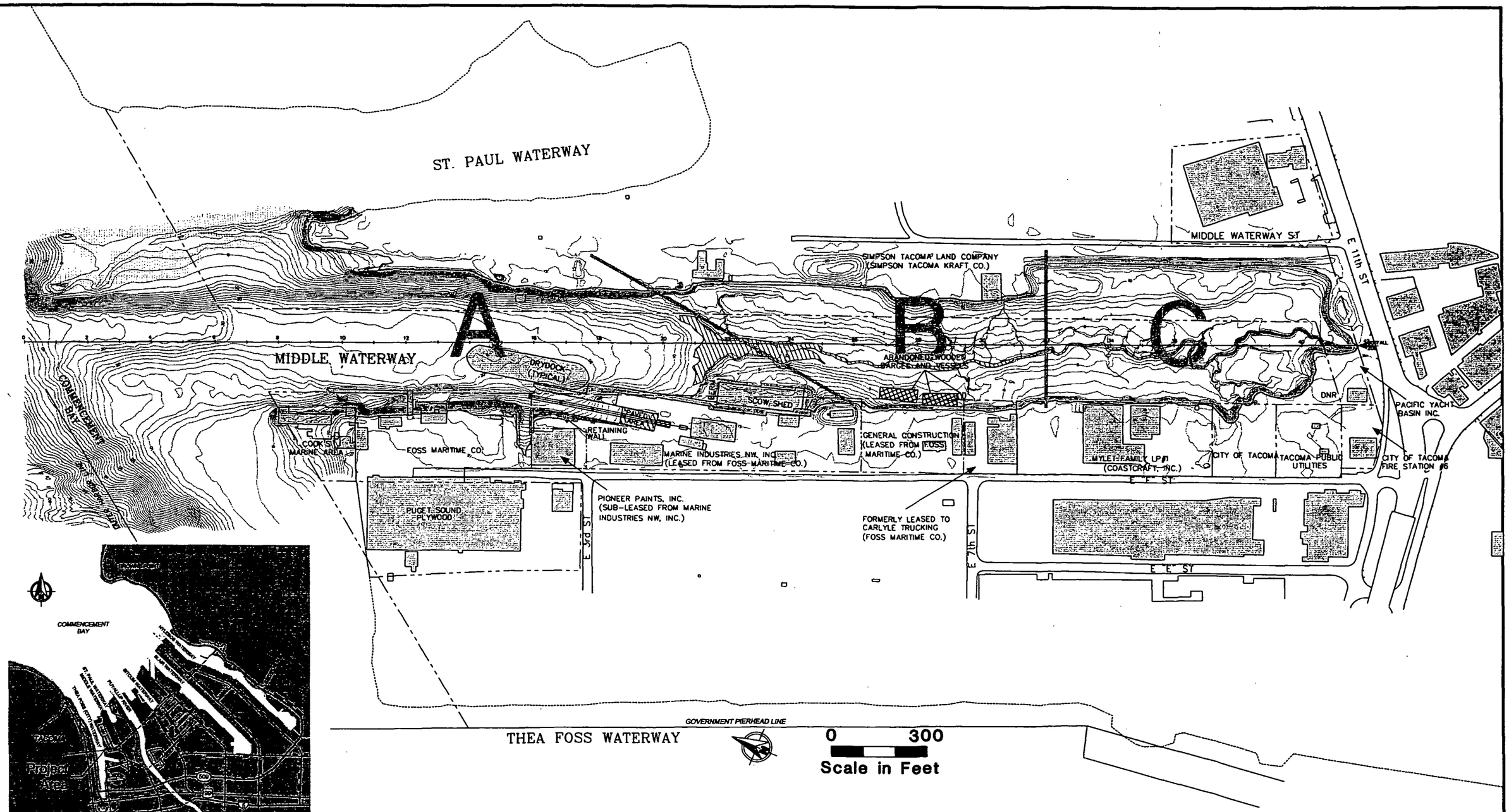
LS = Lump Sum

SF = Square Foot

SF = Square Foot

TBD = To Be Determined

FIGURES



ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

MIDDLE WATERWAY
Protecting the Environment, Promoting the Economy

NOTES:

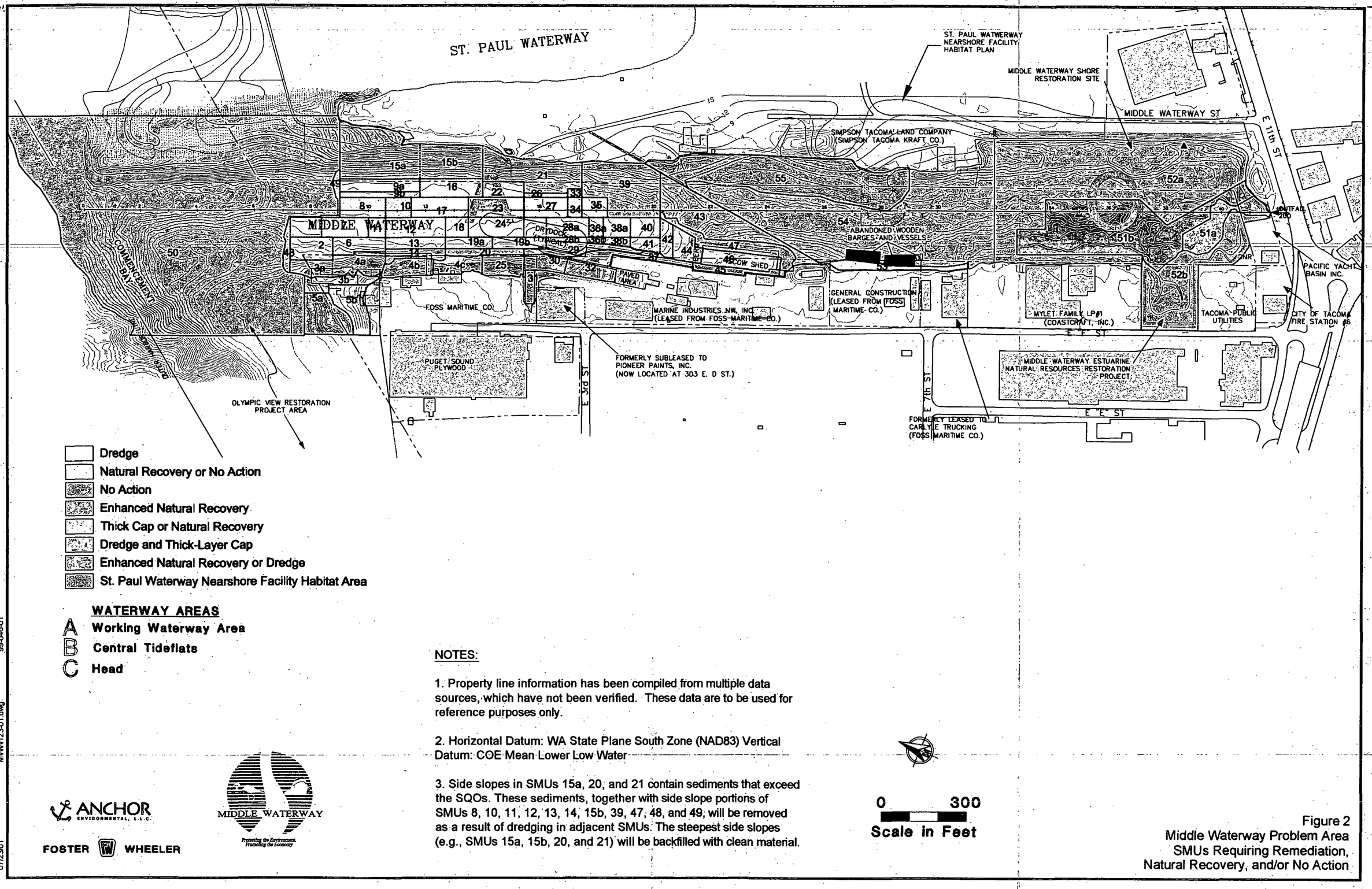
Property line information has been compiled from multiple data sources, which have not been verified. These data are to be used for reference purposes only.

Horizontal Datum: WA State Plane South Zone (NAD83)
Vertical Datum: COE Mean Lower Low Water

Legend

- Existing Tidal Channel Bottom
- Existing Side Channels

Figure 1
Middle Waterway Problem Area
Vicinity and Site Map



NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. These data are to be used for reference purposes only.

2. Horizontal Datum: WA State Plane South Zone (NAD83) Vertical Datum: COE Mean Lower Low Water

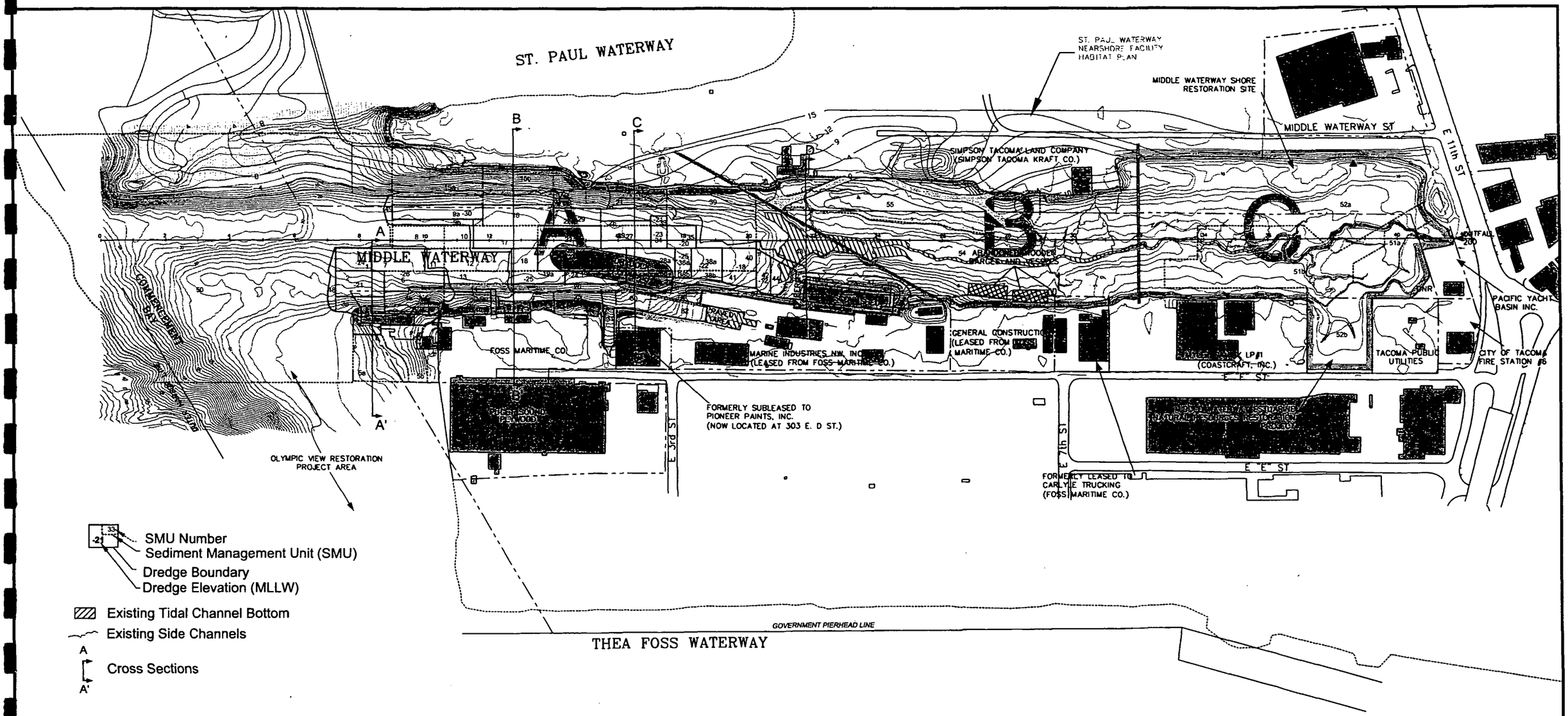
3. Side slopes in SMUs 15a, 20, and 21 contain sediments that exceed the SQOs. These sediments, together with side slope portions of SMUs 8, 10, 11, 12, 13, 14, 15b, 39, 47, 48, and 49, will be removed as a result of dredging in adjacent SMUs. The steepest side slopes (e.g., SMUs 15a, 15b, 20, and 21) will be backfilled with clean material.

0 300
Scale in Feet

ANCHOR ENVIRONMENTAL, L.L.C.
FOSTER WHEELER
MIDDLE WATERWAY
Protecting the Environment, Promoting the Economy

99-046-01
MWW123-01.dwg
07/23/01

Figure 2
Middle Waterway Problem Area
SMUs Requiring Remediation, Natural Recovery, and/or No Action



33 -21 SMU Number
Sediment Management Unit (SMU)
Dredge Boundary
Dredge Elevation (MLLW)

Existing Tidal Channel Bottom

Existing Side Channels

A A' Cross Sections

WATERWAY AREAS

A Working Waterway Area

B Central Tideflats

C Head

MIDDLE WATERWAY
Protecting the Environment, Promoting the Economy

ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

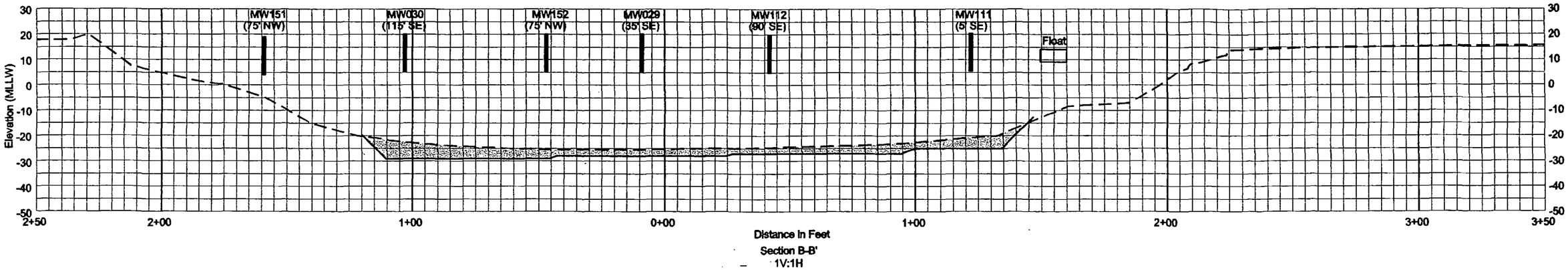
NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. These data are to be used for reference purposes only.

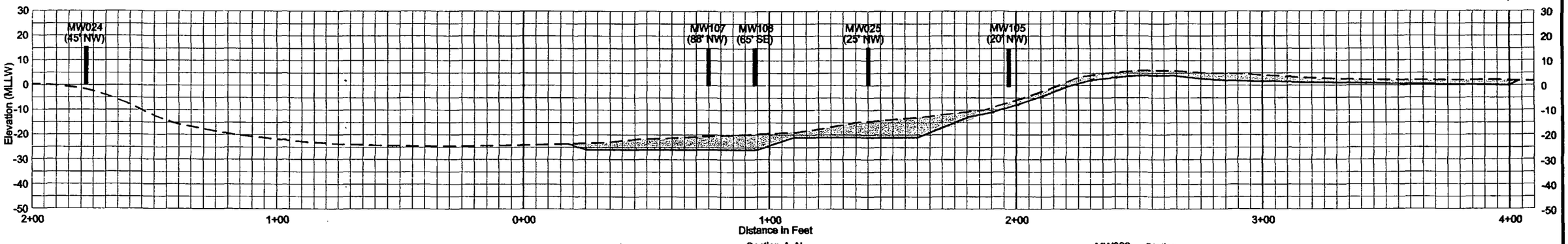
2. Horizontal Datum: WA State Plane South Zone (NAD83) Vertical Datum: COE Mean Lower Low Water.

0 300
Scale in Feet

Figure 3
Middle Waterway Problem Area
Proposed Dredge Plan



Section B-B'
1V:1H



Section A-A'
1V:1H

MW028 (37' SW) Station (offset; distance and direction)

Core Location

Existing Mudline Elevation

99-048-01

06/01/00 MWW122a-01.dwg

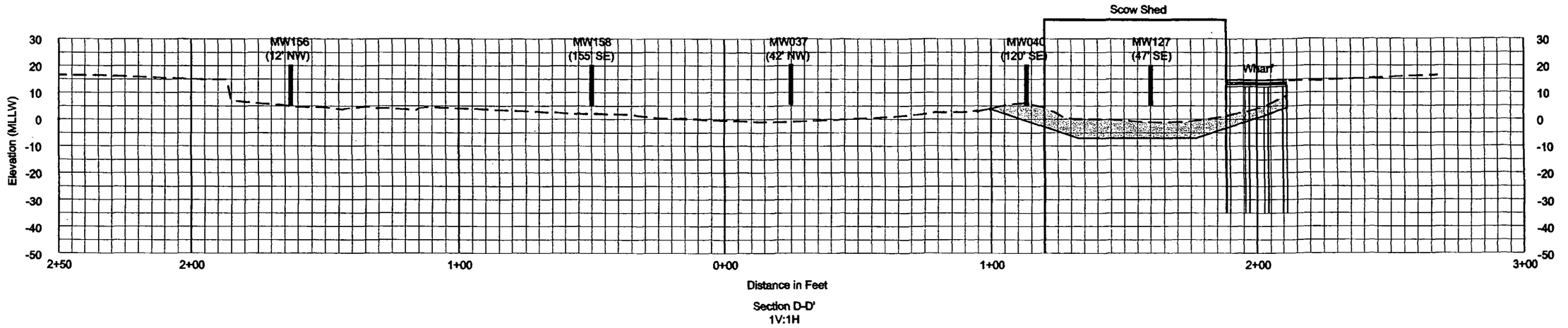
ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

MIDDLE WATERWAY
Protecting the Environment, Promoting the Economy

Horizontal Scale in Feet
0 40
0 40
Vertical Scale in Feet

Figure 4
Middle Waterway Problem Area
Cross Sections A-A', B-B'



99-048-01

08/01/00 MWW122b-01.dwg

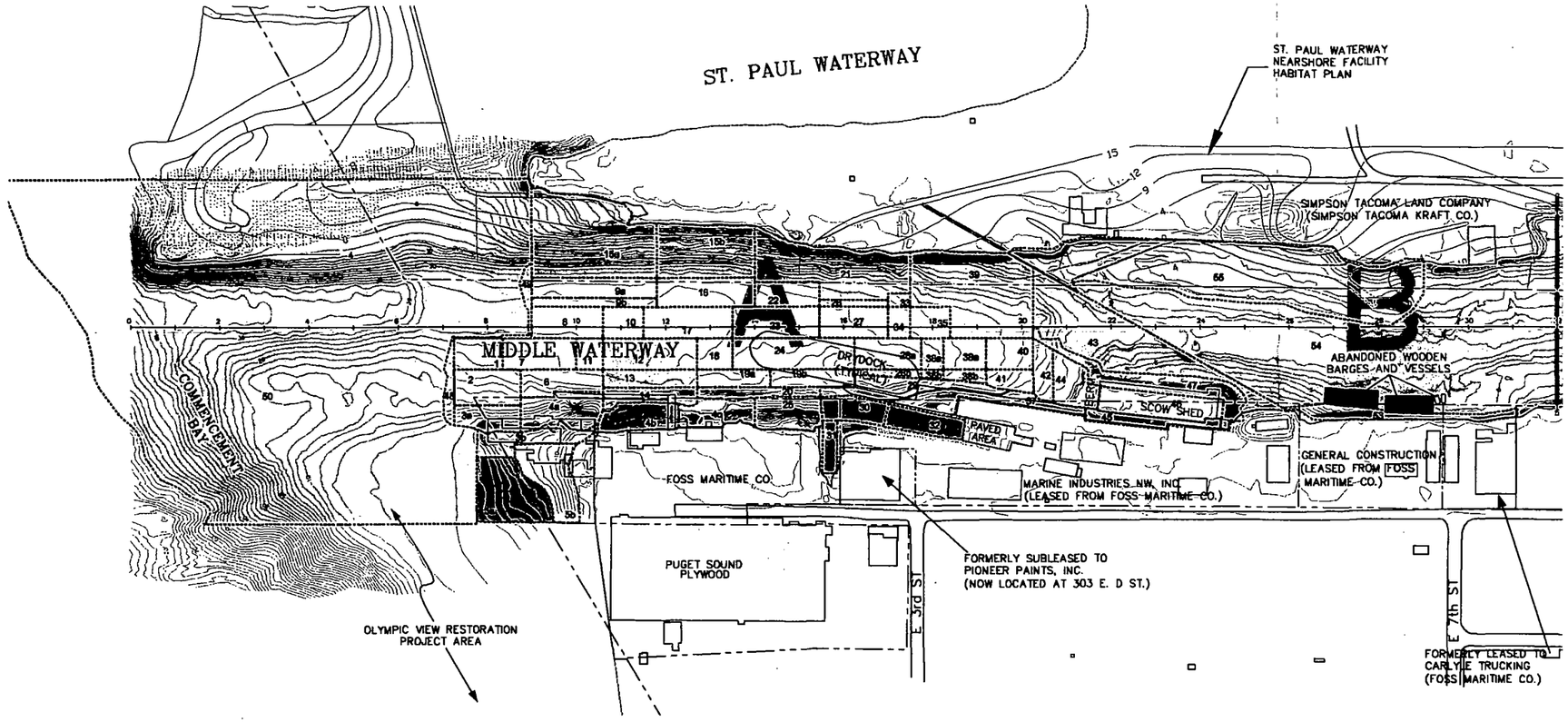
ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

MIDDLE WATERWAY
Protecting the Environment, Promoting the Economy

Horizontal Scale in Feet
0 40
0 40
Vertical Scale in Feet

Figure 5
Middle Waterway Problem Area
Cross Sections C-C', D-D'



- Dredge
- Natural Recovery
- No Action
- Enhanced Natural Recovery
- Dredge and Thick-Layer Cap
- Thick Cap
- St. Paul Waterway Nearshore Facility Habitat Area

WATERWAY AREAS

A **Working Waterway Area**
B **Central Tideflats**
C **Head**

NOTES:

1. Property line information has been compiled from multiple data sources, which have not been verified. These data are to be used for reference purposes only.

2. Horizontal Datum: WA State Plane South Zone (NAD83) Vertical Datum: COE Mean Lower Low Water

3. Side slopes in SMUs 15a, 20, and 21 contain sediments that exceed the SQOs. These sediments, together with side slope portions of SMUs 8, 10, 11, 12, 13, 14, 15b, 39, 47, 48, and 49, will be removed as a result of dredging in adjacent SMUs. The steepest side slopes (e.g., SMUs 15a, 15b, 20, and 21) will be backfilled with clean material.

0 300
Scale in Feet

ANCHOR ENVIRONMENTAL, L.L.C.

FOSTER WHEELER

MIDDLE WATERWAY
Protecting the Environment. Providing the Economy

MWW125-01.dwg 99-046-01
07/23/01

Figure 6
Middle Waterway Problem Area
Recommended Remediation Plan Areas A & B